



# CINNAMON PROCESSING

## Introduction

Cinnamon is a valuable spice that is obtained from the bark of an evergreen tree (*Cinnamomum zeylanicum*) that belongs to the Laurel family. Cinnamon is native to Sri Lanka, Myanmar (Burma) and the southern coastal strip of India. The crop now grows in South America and the West Indies, the Seychelles and Reunion. The best quality cinnamon is produced in Sri Lanka.

Cassia, which is the bark of the evergreen tree *Cinnamomum cassia*, is a similar spice to cinnamon but of an inferior quality. It is a native of Myanmar (Burma). Most of the world's cassia comes from China, Indochina, Indonesia, the East and West Indies and Central America. Cassia bark is coarser and less fragrant than cinnamon and is sometimes used as a substitute.



Figure 1: Cinnamon from Sri Lanka. Photo credit: Practical Action / Neil Noble

Cinnamon gets its distinctive smell and aroma from a volatile oil that is in the bark. The oil can be distilled from off-grade bark, leaves and roots.

Cinnamon must be dried before it is stored and sold for market. This brief outlines the important steps that should be taken pre-harvest and post-harvest to ensure that the dried cinnamon is of top quality for the market.

## Cinnamon production

The cinnamon tree is a bushy evergreen tree that is cultivated as low bushes (about 2-3m tall) to make harvesting easier. The bushes grow well in shaded places with an average rainfall and without extremes of temperature. The optimum temperature for production is between 27 and 30°C. The soil should not be waterlogged as this produces a bitter-tasting bark. Eight or ten side branches grow on the bush and these are harvested after about three years to obtain the cinnamon bark.

## Harvesting

Cinnamon bark is harvested twice a year immediately after each of the rainy seasons when the humidity makes the bark peel more easily. The trees are first harvested when they are three years old, one year after pruning. The side stems that are about three years old are removed and the bark is stripped off. Cinnamon bark is only obtained from stems that are between 1.2 and 5cm in diameter.

technical brief

## Processing

Processing accounts for about 60% of the cost of production of cinnamon. This is because the peeling of bark from the stems is labour intensive and is usually done by hand, by skilled peelers. The quality of cinnamon depends on how well the bark is removed from the stems. The larger pieces or quills can be sold for more than the smaller broken pieces. The Agricultural Engineering University of Ruhuna in Sri Lanka has developed a small mechanised machine for removing the bark from cinnamon stems.

Drying is also an important stage of the processing of cinnamon. It contributes to the quality of the final product.

### Processing stages

- Remove the tender stems (with diameters less than 1.2cm) and use these for mulching.
- Stems with diameters of more than 5cm are not used to prepare cinnamon bark. Remove these and use for oil distillation.
- Remove the soft outer bark using a fine rounded rasp knife.
- Rub the stripped stem with a brass rod to loosen the inner bark. It is important to use a brass rod so that the bark does not become discoloured.
- Make cuts around the stem at 30cm intervals using a small pointed knife. The knife blade should be stainless steel or brass to prevent staining the bark.
- Make long cuts along the length of the stem, so that the bark can be carefully eased off the stem. Use the pointed knife and the rubbing rod to help ease off the bark.
- The pieces of removed bark are known as quills. Place these curled quills inside one another to make long compound quills (up to 1m long). Use the best whole quills on the outside and fill in the centre with broken pieces of bark.

## Drying

The compound quills are placed on coir rope racks and dried in the shade to prevent warping. After four or five days of drying, the quills are rolled on a board to tighten the filling and then placed in subdued sunlight for further drying.

In humid climates or during the rainy season it will be necessary to use a mechanical dryer to complete the drying process. There are a range of dryers available to suit different situations (electrical, gas fired, biomass fuelled). See the Practical Action Technical Brief on drying for further information.

## Grading

The quality of cinnamon is judged by the thickness of the bark, the appearance (broken or entire quills) and the aroma and flavour. The Sri Lankan grading system divides the cinnamon quills into four main groups according to diameter:

Classification	Description	Measurements
1. Quills	Alba	Less than 6mm diameter
	Continental	Less than 16mm diameter
	Mexican	Less than 19mm diameter
	Hamburg	Less than 32mm diameter
2. Quillings	Pieces of bark less than 106mm long	
3. Featherings	Inner bark of twigs and twisted shoots	
4. Chips	Trimnings of quills, outer and inner bark that cant be separated	
5. Powder		
6. Leaf oil		
7. Bark oil	Cinnamaldehyde 30-70%	

## Grinding

Grinding can be a method of adding value to a product. However, it is not advisable to grind spices. After grinding, spices are more vulnerable to spoilage. The flavour and aroma compounds are not stable and will quickly disappear from ground products. The storage life of ground spices is much less than for the whole spices. It is very difficult for the consumer to judge the quality of a ground spice. It is also very easy for unscrupulous processors to contaminate the ground spice by adding other material. Therefore most consumers, from wholesalers to individual customers, prefer to buy whole spices.

Cinnamon is sometimes ground to a powder prior to sale. The ground powder should be packaged in moisture proof packaging (polypropylene bags) to retain the flavour.

## Packaging

Cinnamon quills are cut into pieces up to 10cm in length and packed into moisture-proof polypropylene bags for sale. The bags should be sealed to prevent moisture entering. Sealing machines can be used to seal the bags. Attractive labels should be applied to the products. The label needs to contain all relevant product and legal information – the name of the product, brand name (if appropriate), details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents, added ingredients (if relevant) plus any other information that the country of origin and of import may require (a barcode, producer code and packer code are all extra information that is required in some countries to help trace the product back to its origin). See the Practical Action Technical Brief on labelling for further information on labelling requirements.

## Storage

Dried cinnamon quills must be stored in moisture-proof containers away from direct sunlight. The stored cinnamon quills should be inspected regularly for signs of spoilage or moisture. If they have absorbed moisture, they should be re-dried to a moisture content of 10%.

The storage room should be clean, dry, cool and free from pests. Mosquito netting should be fitted on the windows to prevent pests and insects from entering the room. Strong smelling foods, detergents and paints should not be stored in the same room as they will spoil the delicate aroma and flavour of the cinnamon.

## Equipment suppliers

This is a selective list of suppliers of equipment and does not imply endorsement by Practical Action.

This website includes lists of companies in India who supply food processing equipment.  
[http://www.niir.org/directory/tag/z,,1b\\_0\\_32/fruit+processing/index.html](http://www.niir.org/directory/tag/z,,1b_0_32/fruit+processing/index.html)

## Dryers

### Acufil Machines

S. F. No. 120/2, Kalapatty Post Office  
Coimbatore - 641 035  
Tamil Nadu  
India  
Tel: +91 422 2666108/2669909  
Fax: +91 422 2666255  
Email: [acufilmachines@yahoo.co.in](mailto:acufilmachines@yahoo.co.in)  
[acufilmachines@hotmail.com](mailto:acufilmachines@hotmail.com)  
<http://www.indiamart.com/acufilmachines/#products>

### Industrias Technologicas Dinamicas SA

Av. Los Platinos 228  
URB industrial Infantas  
Los Olivios  
Lima  
Peru  
Tel: +51 14 528 9731  
Fax: +51 14 528 1579

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## **Processing of Cinnamon**

### **1) Peeling and Extraction of Bark:**

Branches, 1 to 2 cm in thickness and which have attained brown colour are cut. The branches should be 1 to 2 years old. Cutting of shoots for extraction of bark is done in May and November. Presence of mature leaves and stopping of new growth of leaves is an indication of free, flow of sap between the bark and the wood. To judge suitability of peelings the peelers make an oblique cut and lift the bark to see whether bark separates easily with free flow of sap to facilitate easy peeling. If there is difficulty in peeling, the shoot is rejected. The cut shoots are collected, bundled and tied to shed for peeling: Peeling is done with a small knife having a round edge at the end. Cut shoots are given longitudinal slits from end to end and two halves of the entire bark are removed.

### **2. Rolling:**

Peeled barks are packed together and placed one above the other and pressed. Length of peeled barks is reduced to 20 cm and these are piled up in small enclosures, covered with dried leaves or mats to preserve moisture for next day's operation and also to aid slight fermentation.

### **3. Piping :**

Peeled and rolled slips are bundled and taken to piping yard. These slips are kept on a horizontal stick supported on a stand. The outer skin of the slip is scrapped-off with a curved knife. These scrapped slips are then graded according to thickness. The graded slips are rolled to form pipes by fitting them over the outer cover of pipes. After piping, slips are dried. Such piped slips are called quills'. The smaller quills are inserted into larger ones to form compound quill. After drying, they are packed in mats for marketing.

Good quality cinnamon should not be thicker than thick paper. It should be light brown with wavy lines and produce 'sound of a fracture' when broken. When chewed, it should become soft, melt in the mouth and sweeten the breath.

### **04. Grading:**

The quills are graded from '00000' being the finest quality, to '0' the coarsest quality. The small pieces of the bark, left after preparing the quills are graded as 'quillings'. The very thin inner pieces of bark are dried as 'featherings'. From the coarser canes, the bark is scrapped-off, instead of peeling and this grade is known as 'scrapped chips'. The bark is also scrapped-off without removing the outer bark and is known as 'unscrapped chips'. The different grades of bark are powdered to get 'cinnamon powder'.

## **Processing of Cinnamon**

### **Harvesting**

The plant is harvested during the wet season since the rains facilitate the peeling of the bark. Harvesting involves the removal of the stems. This takes place early in the morning.

### **Processing**

- The tender stems (with diameters of less than 1.2cm) are removed and used for mulching.
- Stems with diameters of more than 5cm are not used to prepare cinnamon bark.
- The leaves are removed and can be used for oil distillation.
- The soft outer bark is stripped off using a fine rounded rasp knife.
- The stripped stem is rubbed with a brass rod to loosen the inner bark.
- Cuts are made around the stem at 30cm intervals using a small pointed knife. This knife should be stainless steel or brass to prevent staining.
- The longitudinal cuts are made on either side of the stem and the bark carefully eased off using pointed knife and rubbing rod.
- The curled pieces of peeled bark (quills) are placed one inside another to make 1m long 'compound quills'. The best quills are placed on the outside and broken and small pieces in the centre.

### **Drying**

The 'compound quills' are placed on coir rope racks and dried, in the shade to prevent warping.

### **Grinding**

Grinding may add value but must be done carefully as there are difficulties. A whole, intact product can be easily assessed for quality whereas a ground product is more difficult. There is a market resistance to ground spices due to fear of adulteration or the use of low quality cinnamon. This can only be overcome by producing a consistently high quality product and gaining the confidence of customers.

## **Storage of Onion**

- The bulbs are hardy and keep well if they are harvested at the right time and hardened off. The proper time to dig them up is when the sprouts have died back.
- Then they need to be cured. Curing dries the outer skins of the bulb so it will not be as prone to rot and mold.

- Spread the onions out in a single layer on a clean, dry surface. Let them dry for two or three weeks until the necks are dry and the skin is papery. After they are cured, storing onions can be done in a couple of different ways.
- Cut off the tops or necks of the onions after they are cured. Discard any that show signs of decay or have soft spots. Use any bulbs that have thick necks first because they are more moist and don't store as well.
- A fun way of storing onions is to put them in an old nylon stocking. Make knots between each bulb and hang the nylon. This keeps air circulation flowing and you can just cut a knot off as you need a vegetable.
- Another method of storing garden onions is to set them in a basket or crate. Any container will do as long as there is airflow.
- All produce keeps best in cooler conditions, which slow down the decay process.
- Onions should be kept where temperatures are 32 to 40 degrees Fahrenheit. An unheated basement or garage is suitable as long as temperatures don't freeze inside.
- The location must also be dry and low in humidity to prevent rot and molds. The length of time you can store onions will depend on variety and site conditions.
- Some bulbs can be stored for several months.

**OR**

### **Storage of Onion**

- i. Onions should be harvested when most of the tops have fallen over and begun to dry. Carefully pull or dig the bulbs with the tops attached.
- ii. After harvesting, dry or cure the onions in a warm, dry, well-ventilated location, such as a shed or garage. Spread out the onions in a single layer on a clean, dry surface.
- iii. Cure the onions for two to three weeks until the onion tops and necks are thoroughly dry and the outer bulb scales begin to rustle.
- iv. After the onions are properly cured, cut off the tops about 1 inch above the bulbs. As the onions are topped, discard any that show signs of decay.
- v. Use the thick-necked bulbs as soon as possible as they don't store well. An alternate preparation method is to leave the onion tops untrimmed and braid the dry foliage together.
- vi. Place the cured onions in a mesh bag, old nylon stocking, wire basket, or crate. It's important that the storage container allow air to circulate through the onions.
- vii. Store the onions in a cool, moderately dry location. Storage temperatures should be 32 to 40 degrees F. The relative humidity should be 65 to 70 percent.

- viii. Possible storage locations include a basement, cellar, or garage. Hang the braided onions from a rafter or ceiling.
- ix. Since the temperature in an unheated garage may fall well below 32 degrees F, an alternate storage site will be needed when bitterly cold weather arrives.
- x. The storage life of onions is determined by the variety and storage conditions. When properly stored, good keepers, such as Copra and Sweet Sandwich, can be successfully stored for several months.
- xi. Poor keepers, such as Walla Walla and Sweet Spanish, can only be stored for a few weeks. If the storage temperatures are too warm, the onions may sprout.
- xii. Rotting may be a problem in damp locations. Inspect the stored onions on a regular basis in fall and winter. Discard any that are starting to rot.
- xiii. On a cold, snowy day, it's nice to be able to go to the basement or cellar and grab an onion and prepare a pot of stew or chili.
- xiv.** That and numerous other culinary delights are possible when onions are harvested and stored properly.<sup>1</sup>

### **Curing of Onion**

- I. Onions should be adequately cured in the field, in open sheds, or by artificial means before or in storage. Adequate curing in the field or in open sheds may require 2 to 4 weeks, depending on the weather.
- II. The best skin color develops at 75 to 90°F. The most common method of curing in northern areas is by forced ventilation in the storage by blowing heated air at 75 to 85°F, through the bottom of the onion pile to the top, at two to three cubic feet of air per minute for each cubic foot of onions (or 30-50cfm/ton).
- III. Use the higher air-flow rate initially to remove surface moisture and seal necks. If the weather is cool and wet, forced air at 75 to 85°F and 70% relative humidity is recommended.
- IV. If the onions are also wet, forced air at 85°F and a relative humidity of 25-35% relative humidity should be used as soon as storage loading is completed. This should be continued until the outer skins and neck are dry.
- V. Onions are considered cured when the neck is tight and the outer scales are dry and make a rustling sound when handled.
- VI. This condition is reached when onions have lost 3 to 5 % of their weight. If not adequately cured, onions are likely to decay in storage.

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<sup>1</sup> By Richard Jauron, Extension Horticulturalist, Iowa State University

- VII. The common form of decay is gray mold rot (*Botrytis*), which occurs at the top of the bulb - hence its name "neck rot".

High temperatures and high humidity (80%) during curing with good air circulation favor development of desirable skin color.<sup>2</sup>

## **Curing of Potato**

Curing is a process that will further toughen up the skin of the tubers. Place the potatoes where there are moderate temperatures but high humidity for ten days. Before storage, potatoes should be culled and cured. Cull and discard any damaged, diseased or frozen tubers. Curing potatoes heals the skin, making it less susceptible to damage and disease.

1. In late summer when the potato foliage has died back, potatoes can be dug and "cured" for storage. Curing toughens up a potato's skin and extends its storage life.
2. Cure potatoes by exposing them to temperatures between 50 and 60 degrees F and 95% relative humidity for 10 to 14 days.
3. Cure the tubers by laying them out on newspaper in a well-ventilated place that's cool (50 to 60 degrees F.) and dark (so they don't turn green).
4. After about two weeks, the skins will have toughened up. Rub off any large clumps of dirt (potatoes should never be washed before storage) and cull any damaged tubers, which should be eaten, not stored.
5. Treat the tubers very gently so as not to bruise or cut them. Nestle your spuds into ventilated bins, bushel baskets, a Root Storage Bin or a cardboard box with perforated sides.
6. Completely cover the boxes or baskets with newspaper or cardboard to eliminate any light. Even a little light will cause potatoes to turn green and be rendered inedible.

## **Prunning of Tomato**

- Pruning means pinching off the shoots or "suckers" that sprout from the stem in the crotch right above a leaf branch.
- Pruning a tomato plant can help promote fruit growth and better air circulation.
- Always prune on a sunny day with a good forecast.

### **Steps of Prunning**

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<sup>2</sup> University of Minnesota



**Locate the suckers for removal-** Suckers left to grow will take energy from the rest of the plant and cause the plant to bear fewer fruits. This isn't always a bad thing, but strategically removing suckers will help the plant bear large fruit all season long.

**Remove all suckers and their leaves below the first flower cluster-** This keeps the plant strong by helping it grow a sturdy central stem. To remove a sucker, grab a growing tip by the base between the thumb and forefinger and bend it back and forth until it snaps cleanly. This should ideally be done when the shoot is young and supple. The small wound will heal quickly. This is called "simple pruning". As for stems and leaves, not the suckers, growing below the first flower cluster

**Leave the thicker shoots-** Thicker suckers should not be snapped off, since this could damage the whole plant. If it's thicker than a pencil, use the "Missouri pruning" method and pinch out just the tip of the sucker, leaving one or two leaves behind for photosynthesis and to protect developing fruit from sun scald. This method also leaves a few inches on the sucker to reduce the shock to the plant. Prune suckers all summer long to keep the plant healthy. They grow quickly, so may need to prune once or twice a week.

**Remove yellow leaves-** Yellow leaves are leaves that use up more sugar than they produce. As the plant begins to mature, the lower leaves will naturally begin to yellow and wilt. This is perfectly normal, so pull these from the plant when they appear. It will keep the plant fresh and help ward off disease.

**Pruning Roots-** Root pruning is a special trick that can use to speed up the ripening of early tomatoes. By cutting the roots, put quite a bit of stress on the plant, which causes it to mature more quickly. To root-prune trench-planted tomatoes, take a long kitchen knife and make a cut down along just one side of the buried main stem, 1 to 2 inches away from it, going down 8 to 10 inches. If the tomatoes are planted vertically, cut halfway around the plant, 1 or 2 inches from the stem and 8 to 10 inches deep. If a knife doesn't work well, try a spade or a shovel.

**Top the plant-** To get the best out of the last growth of the season, it is necessary to "top" the plant. About a month before the first expected frost, remove the plant's terminal shoot. At this point in the season, the tomatoes currently growing will have a limited time to reach maturity, so all nutrients must be directed straight to the fruit.

## Cole Crops

"Cole" refers to any of various plants belonging to the Cruciferae or mustard family.

This group of crops belongs to the family Cruciferae, and is thus also referred to as cruciferous crops or crucifers. The commercially important crops all belong to the genus *Brassica*, hence the reference to brassica crops or simply brassicas.

The botanical names of these crops, are:

- Cabbage - *Brassica oleracea* L. var. *capitata*.
- Cauliflower - *B. oleracea* L. var. *botrytis*

- Sprouting broccoli (or calabrese) - *B. oleracea L. var. italica*.
- Brussels sprouts - *B. oleracea L. var. gemmifera*.

Some other vegetables in the same family include chinese cabbage, choumoellier, horseradish, kohlrabi, kale, various mustards, radish, turnip, swede (or rutabago), as well as a number of lesser-known vegetables.

### **Flowering characteristics of Cole crops**

- The flowers form ebracteate racemose. flowers are borne in terminal racemes which develop on the main stem and all its branches.
- The bright yellow hypogynous flowers borne on slender pedicels are perfect, regular.
- The flower have 4-free saccate sepals, 4- free clawed petals, 6-stigma with a 2-celled ovary containing many ovules per cell.
- The ovary is superior.
- They can be disymmetric or slightly zygomorphic, with a typical cross-like arrangement.
- Cole crops generally cross-pollinated crop. Pollination occurs by entomogamy; nectar is produced at the base of the stamens and stored on the sepals.
- The pistil is made up of two fused carpels and the style is very short, with two lobes.
- The inflorescence is dwarfer and umbrella-shaped and often apically corymb-like.
- The stored nutrients are used to produce a flower spike 1 to 2 metres (3–7 ft) tall bearing numerous yellow flowers.

### **Fruit Setting in Bottle Gourd**

Fruit set in cucurbit are very much influenced by environmental factors. Usually fruit set takes place, in early morning.

Majority of cucurbit flowering 30-45 days after sowing and follows a definite sequence. An alternate sequence of male and female flower fallow upto fruit set.

In bottle gourd later in the day and set fruit at higher temperature of midday. slightly wet to semi dry ecological condition is suitable for this crop. Night and day temperature 18-22<sup>0</sup> C and 30-35<sup>0</sup> C is optimum for its fruit set. In bottle gourd, both staminate and pistillate flowers open between 4.30 and 6.00 pm.

Natural pollination supplemented with hand pollination is the most successful for fruit set. Fruit set can be increased by spraying twice at 2 or 4 leaf stage with maleic hydrazide (400 ppm), boron (3 ppm), calcium (20 ppm) etc.

***Flowering and Fruit Set***

In the main summer season crop flowering starts at about 40 days after sowing. Generally male flowers appear first at about 10th node and female flowers follow the sequence and appear at 8th to 15th node. Thereafter the flush of male and female flowers continue to occur in the plants for next 50-80 days till the latter decay and die. The ratio of male:female flower may vary from 5:1 to 15:1 in the common types. Sex ratios are highly sensitive to environment and nitrogen application. Long days, high temperature, and high nitrogen rates promote greater number of male flowers. In cool weather, numerous female flowers may be borne in bottlegourd plants (Figure 6) than male flowers, but all the female flowers do not turn into fruits. In general, higher proportions of female flowers are borne in a plant even during summer but only a few turns into fruits. First green edible fruits are available in 55-65 days after sowing in early varieties.